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The effect of CO_2 on carbon isotope discrimination in C_4 monocots (grasses) and dicots

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The presence or prevalence of C_4 plants within paleoecosystems is widely invoked to gain insight into paleoclimate conditions, herbivore paleoecology, landscape evolution, and more. Stable carbon isotope analyses of fossilized terrestrial substrates, such as paleosols, are a preferred method for such studies, due to the conspicuously high carbon isotope value ($\delta^{13}C$) of C_4 plant tissue, relative to C_3 plants growing in the same environment. Because C_4 photosynthesis features the enzyme PEP-carboxylase, which works to actively pre-concentrate CO_2 prior to fixation by RuBP, workers have assumed the $\delta^{13}C$ of C_4 plants to be independent of the CO_2 level of the atmosphere. We set out to test this assumption across a wide range of CO_2 (400-1400 ppm) in a diverse set of C_4 plants. Specifically, we included three C_4 dicot genera (*Amaranthus*, *Atriplex* and *Gomphrena*), extant weedy species commonly found in North America. To compliment these experiments, we included four genera of monocots (*Eleusine, Dactyloctenium, Sorghum, Setaria*), all grasses. We found strongly divergent trends between the two groups: all monocots showed no change in $\delta^{13}C$ value with increasing CO_2. All dicots, however, showed strong linear decreases (R^2 = 0.97-0.99) in $\delta^{13}C$ value with increasing CO_2 level. These results suggest that when quantifying C_3 versus C_4 abundances using $\delta^{13}C$ data, changes in CO_2 level must be considered when estimating endmember $\delta^{13}C$ values, particularly when significant dicot contribution is obvious, or cannot be ruled out.